

WHAT IS CLAIMED:

1. A system for enabling the capture of embolic material which may be released into a blood vessel during a therapeutic interventional procedure, comprising:

5 a guide wire, including a distal end, adapted to be positioned within the blood vessel and to extend to a position distal to an interventional procedure site; and

a filter device, adapted to be positioned and deployed at a location in the patient's vasculature distal to the interventional procedure site, and to capture embolic material which may be released into the blood in the blood vessel during the
10 interventional procedure, including an engaging element, for enabling the filter device to be snap-fitted so as to engage the distal end of the guide wire.

2. The system of claim 1, wherein the filter device includes a pre-formed expandable shape thereof, including a pre-formed expandable maximum outer diameter portion, adapted to expand against the inner surface of the wall of the blood vessel, and to extend along and seal off the inner surface of the blood vessel wall,
5 upon expansion of the filter device for deployment thereof, so as to inhibit the formation of a gap between the filter device and the blood vessel wall through which embolic material may otherwise flow.

3. The system of claim 1, wherein the length of the filter device is foreshortened, such that the length thereof is shortened for insertion thereof through the patient's vasculature.

4. The system of claim 1, wherein the filter device, upon being snap-fitted to the distal end of the guide wire, is adapted to enable rotational movement of the filter device independent of rotational movement of the guide wire, and to inhibit translational movement of the filter device relative to the guide wire.

5 5. The system of claim 1, further including a proximal stop and a distal stop, adapted to be secured to the distal end of the guide wire, and having a space between the proximal stop and the distal stop, and adapted to enable the engaging element of the filter device to be engaged with the proximal stop and the distal stop in the space between the proximal stop and the distal stop.

6. The system of claim 1, wherein the filter device includes a cage, adapted to be engaged with the distal end of the guide wire, and filter material, for filtering embolic material, secured to the cage.

7. The system of claim 1, wherein the guide wire includes a tip coil, at the distal end of the guide wire, the tip coil includes a proximal portion, and the system further comprises an obturator, which includes a distal portion, wherein the distal portion of the obturator is adapted to extend over the proximal portion of the tip coil.
5 coil.

8. The system of claim 2, wherein the filter device includes a cage, adapted to be engaged with the distal end of the guide wire, and wherein the cage includes a plurality of struts.

9. The system of claim 2, wherein the pre-formed expandable shape of the filter device comprises a heat-treated shape.

10. The system of claim 3, wherein the foreshortened length of the filter device is between about 1 centimeter and 1.5 centimeters.

11. The system of claim 5, wherein the engaging element of the filter device comprises at least one tab, adapted to engage the proximal stop and the distal stop in the space between the proximal stop and the distal stop.

12. The system of claim 5, further comprising a hypotube, adapted to extend about the proximal stop, the engaging element of the filter device, the distal stop, and a portion of the guide wire.

13. The system of claim 6, wherein the cage includes a plurality of struts.

14. The system of claim 6, wherein the cage includes a proximal end, and the engaging element is located at the proximal end of the cage.

15. The system of claim 6, wherein the guide wire includes a tip coil, at the distal end of the guide wire, the tip coil includes a proximal portion, the filter material includes a distal portion, and the distal portion of the filter material is adapted to extend over the proximal portion of the tip coil.

16. The system of claim 7, wherein the cage includes a distal end, the obturator further includes a proximal portion, and the proximal portion of the obturator is adapted to extend over the distal portion of the cage.

17. The system of claim 7, wherein the filter device includes a cage, adapted to be snap-fitted onto the distal end of the guide wire, and filter material, for filtering embolic material, and the filter material includes a proximal end, secured to the cage, and a distal portion, and the proximal portion of the obturator extends over
5 the distal portion of the filter material.

18. The system of claim 8, wherein the cage includes a pre-formed expandable shape thereof, including a pre-formed expandable maximum outer diameter portion, adapted to expand against the inner surface of the wall of the blood vessel, and to extend along and seal off the inner surface of the blood vessel wall, upon expansion
5 of the cage for deployment thereof, so as to inhibit the formation of a gap between the cage and the blood vessel wall through which embolic material may otherwise flow, and wherein the plurality of struts include a plurality of proximal ribs, a plurality of distal ribs, and a ring extending intermediate the plurality of proximal ribs and the plurality of distal ribs and comprising the pre-formed expandable maximum outer
10 diameter portion of the cage.

19. The system of claim 12, wherein the hypotube includes a distal end, and the distal end of the hypotube is variably flexible.

20. The system of claim 13, wherein each of the plurality of struts is adapted to absorb pulsations in the patient's vasculature.

21. The system of claim 18, wherein the ring includes a plurality of segments.

22. The system of claim 18, wherein the filter device further includes filter material, for filtering embolic material, secured to the cage, and wherein the filter material is attached to the pre-formed expandable maximum outer diameter portion of the cage so as to extend under the distal portion of the ring and over the proximal
5 portion of each of plurality of ribs.

23. The system of claim 18, wherein the filter device further includes filter material, for filtering embolic material, secured to the cage, and wherein the filter material is attached to the pre-formed expanded maximum outer diameter portion of the cage, so as to extend over the distal portion of the ring and over each of the plurality
5 of ribs.

24. The system of claim 20, wherein the plurality of struts includes a plurality of proximal ribs, and each of the plurality of proximal ribs is generally s-shaped.

25. The system of claim 21, wherein the plurality of segments include adjacent pairs of segments.

26. The system of claim 25, wherein each adjacent pair of segments forms a generally v-shaped section of the ring.

27. A system for enabling the capture of embolic material which may be released into a blood vessel during a therapeutic interventional procedure, comprising:

5 a guide wire, including a distal end, adapted to be positioned within the blood vessel and to extend to a position distal to an interventional procedure site; and

10 a filter device, adapted to be positioned and deployed at a location in the patient's vasculature distal to the interventional procedure site, and to capture embolic material which may be released into the blood in the blood vessel during the interventional procedure, including a pre-formed expandable shape thereof, which includes a pre-formed expandable maximum outer diameter portion, adapted to expand against the inner surface of the wall of the blood vessel, and to extend along and seal off the inner surface of the blood vessel wall, upon expansion of the filter device for deployment thereof, so as to inhibit the formation of a gap between the filter device and
15 the blood vessel wall through which embolic material may otherwise flow.

28. The system of claim 27, wherein the filter device includes an engaging element, for enabling the filter device to be snap-fitted so as to engage the distal end of the guide wire.

29. The system of claim 27, wherein the length of the filter device is foreshortened, such that the length thereof is shortened for insertion thereof through the patient's vasculature.

30. A system for enabling the capture of embolic material which may be released into a blood vessel during a therapeutic interventional procedure, comprising:

5 a guide wire, including a distal end, adapted to be positioned within the blood vessel and to extend to a position distal to an interventional procedure site; and

10 a filter device, adapted to be positioned and deployed at a location in the patient's vasculature distal to the interventional procedure site, and to capture embolic material which may be released into the blood in the blood vessel during the interventional procedure, wherein the length of the filter device is foreshortened, such that the length thereof is shortened for insertion thereof through the patient's vasculature.

31. The system of claim 30, wherein the filter device includes an engaging element, for enabling the filter device to be snap-fitted so as to engage the distal end of the guide wire.

32. The system of claim 30, wherein the filter device includes a pre-formed expandable shape thereof, including a pre-formed expandable maximum outer diameter portion, adapted to expand against the inner surface of the wall of the blood vessel, and to extend along and seal off the inner surface of the blood vessel wall, 5 upon expansion of the filter device for deployment thereof, so as to inhibit the formation of a gap between the filter device and the blood vessel wall through which embolic material may otherwise flow.

33. A system for enabling expandable material to be pre-formed into an expandable configuration of a cage for a filter device, for pre-forming the cage, for

enabling the filter device to capture embolic material which may be released into a blood vessel during a therapeutic interventional procedure, wherein the expandable
5 configuration of the cage to be pre-formed by the system provides a substantially uniform pre-formed expandable maximum outer diameter portion thereof, for maintaining vessel wall opposition in a patient's vasculature upon deployment of the cage at a location distal to an interventional procedure site, comprising:

10 a male mandrel element, adapted to enable the expandable material to be extended thereover, including a maximum outer diameter portion extending along the length thereof which is substantially uniform and is substantially equal to the maximum inner diameter portion of the expandable configuration of the cage to be formed thereby; and

15 a female die element, adapted to enable the expandable material to be formed therein, adapted to extend over the male mandrel member and the expandable material, having a cavity therein, the length of which extends for at least a portion of the length of the male mandrel member, the maximum diameter of which is substantially uniform and is substantially equal to the maximum outer diameter portion of the expandable configuration of the cage to be formed thereby.

34. The system of claim 33, wherein the expandable material for forming the expandable configuration of the cage is adapted to be in the form of a hypotube for extending over the male mandrel element, over which the female die element is adapted to extend.

35. The system of claim 33, wherein the main section of the male mandrel element includes a distal end, the male mandrel element further includes a tapered section, which extends from the distal end of the main section, for enabling the expandable material for forming the expandable configuration of the cage to be
5 extended over the tapered section of the male mandrel element with a gradual transition thereof so as to minimize failure of the material resulting from fatigue or damage during expansion thereof.

36. The system of claim 33, wherein the cavity in the female die element is generally complementary to the male mandrel element, and the female die element is adapted to extend over the male mandrel element and the expandable material for forming the expandable configuration of the cage, so as to lock the male
5 mandrel element and the material therein.

37. The system of claim 33, wherein the hypotube of expandable material includes a plurality of ends, and the system further comprises a plurality of springs adapted to be connected to an end of the hypotube of expandable material to enable a portion of the cage, to be formed from the hypotube of expandable material
5 by the system, to be in tension, so as to aid in the tracking and deploying of the cage in tortuous vasculature.

38. The system of claim 36, wherein the male mandrel element includes a generally pin-shaped channel therein which extends therethrough, for enabling a pin to extend therethrough for alignment thereof.

39. A method of enabling the capture of embolic material which may be released into a blood vessel during a therapeutic interventional procedure, in a system which comprises a guide wire, including a distal end, adapted to be positioned within the blood vessel and to extend to a position distal to an interventional procedure
5 site, and a filter device, adapted to be positioned and deployed at a location in the patient's vasculature distal to the interventional procedure site, and to capture embolic material which may be released into the blood in the blood vessel during the interventional procedure, including an engaging element, for enabling the filter device to be snap-fitted so as to engage the distal end of the guide wire, wherein the method
10 comprises:

snap-fitting the filter device so as to engage the distal end of the guide wire;

inserting the filter device and the guide wire to the location in the patient's vasculature distal to the interventional procedure site; and

5 expanding the filter device for deployment thereof.

40. A method of enabling expandable material to be pre-formed into an expandable configuration of a cage for a filter device, for pre-forming the cage, for enabling the filter device to capture embolic material which may be released into a blood vessel during a therapeutic interventional procedure, wherein the expandable
5 configuration of the cage to be pre-formed by the system provides a substantially uniform pre-formed expandable maximum outer diameter thereof, for maintaining vessel wall opposition in a patient's vasculature upon deployment of the cage at a location distal to an interventional procedure site, in a system which comprises a male mandrel element, adapted to enable the expandable material to be extended thereover,
10 including a maximum outer diameter portion extending along the length thereof which is substantially uniform and is substantially equal to the maximum inner diameter of the expandable configuration of the cage to be formed thereby, and a female die element, adapted to enable the expandable material to be formed therein, adapted to extend over the male mandrel member and the expandable material, having a cavity
15 therein, the length of which extends for at least a portion of the length of the male mandrel member, the maximum diameter of which is substantially uniform and is substantially equal to the maximum outer diameter portion of the expandable configuration of the cage to be formed thereby, wherein the method comprises:

 extending the expandable material over the maximum outer diameter
20 portion of the male mandrel element, so as to form the maximum inner diameter of the expandable configuration of the cage to be formed thereby; and

extending the cavity in the female die element over the male mandrel element and the expandable material, so as to form the maximum outer diameter portion of the expandable configuration of the cage to be formed thereby.
